

*Office of Environmental Management – Grand Junction*



# Moab UMTRA Project Flood Response Summary

Revision 0

October 2014



U.S. Department  
of Energy

## **Office of Environmental Management**

**Moab UMTRA Project  
2014 Flood Response Summary**

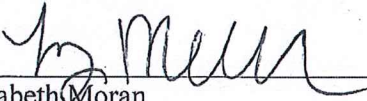
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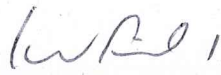
**October 2014**

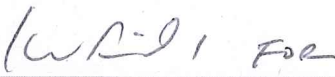
Moab UMTRA Project  
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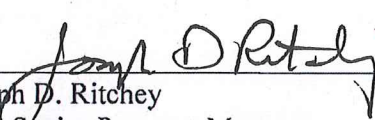
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Review and Approval

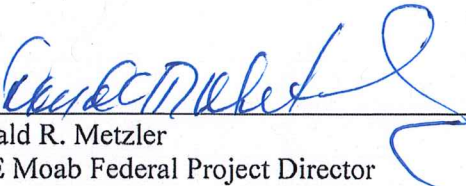
  
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## Revision History

Revision No.	Date	Reason/Basis for Revision
0	October 2014	Initial issue.

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## Acronyms and Abbreviations

amsl	above mean sea level
CA	Contamination Area
CF	Configuration
cfs	cubic feet per second
cps	counts per second
DNR	Division of Natural Resources
DOE	U.S. Department of Energy
ft	foot or feet
GS/GPS	gamma scan/global positioning system
in.	inch or inches
OCS	Opposed Crystal System
pCi/g	picocuries per gram
Ra-226	radium-226
RAC	Remedial Action Contractor
TAC	Technical Assistance Contractor
UMTRA	Uranium Mill Tailings Remedial Action
USGS	U.S. Geological Survey
VFDs	variable frequency drives

## 1.0 Introduction

The Colorado River forms the eastern boundary of the Moab Uranium Mill Tailings Remedial Action (UMTRA) Project site. On May 22, 2014, river flow exceeded its banks and entered the site in the north off-pile area. Floodwaters entered other parts of the site during the following weeks. This Flood Response Summary documents the pre-flood, flood, and post-flood observations and actions taken at the site. Figure 1 shows Moab site features and elevations of on-site berms. For purposes of this Summary, “well field area” is defined as the area shown on Figure 1.

The *Moab UMTRA Project Flood Mitigation Plan* (DOE-EM/GJTAC1640) outlines flood preparation actions at three river flow levels to be completed by the Technical Assistance Contractor (TAC) and Remedial Action Contractor (RAC). Action levels are designated for Colorado River flows at the Cisco gage of 15,000 cubic feet per second (cfs), 25,000 cfs, and 35,000 cfs or greater.

Appendices A and B of this Summary include photographs of the site in flooded and post-flood conditions. The photo captions include Colorado River flow at the Cisco gage and elevation at the Moab site gage. Appendix C contains the post-flood radiological survey results, and Attachment 1 contains a letter from the Utah Division of Natural Resources (DNR) regarding post-flood fish seining.

### 1.1 Purpose and Scope

The purpose of this document is to record the chronology, on-site river flow elevation, actions, and lessons learned associated with the above-average spring runoff of 2014. River flow and stage data will be useful for planning future activities on site, including operations and restoration. This report provides a summary of flood potential monitoring, the flood event, and activities to restore operations.

The pre-flood period is defined as from early February through May 21. The flood period is defined as May 22 to June 27, when river water actively flowed onto the site. The post-flood period is defined as June 28 to September 4, when ponded surface water remained on site.

### 1.2 Cisco and Site Gages

Colorado River flow measurements are taken from the U.S. Geological Survey (USGS) gaging station 09180500 near Cisco, Utah, and are compared to the elevation measurements, which are made at the Moab site gage.

The gradient of the river (the elevation drop over a given distance divided by the distance) varies from the site gage to the southern portion of the site at approximately 1 foot (ft) per 0.5 miles; therefore, elevations at other site locations must be adjusted to compare them to the elevation at the site gage.



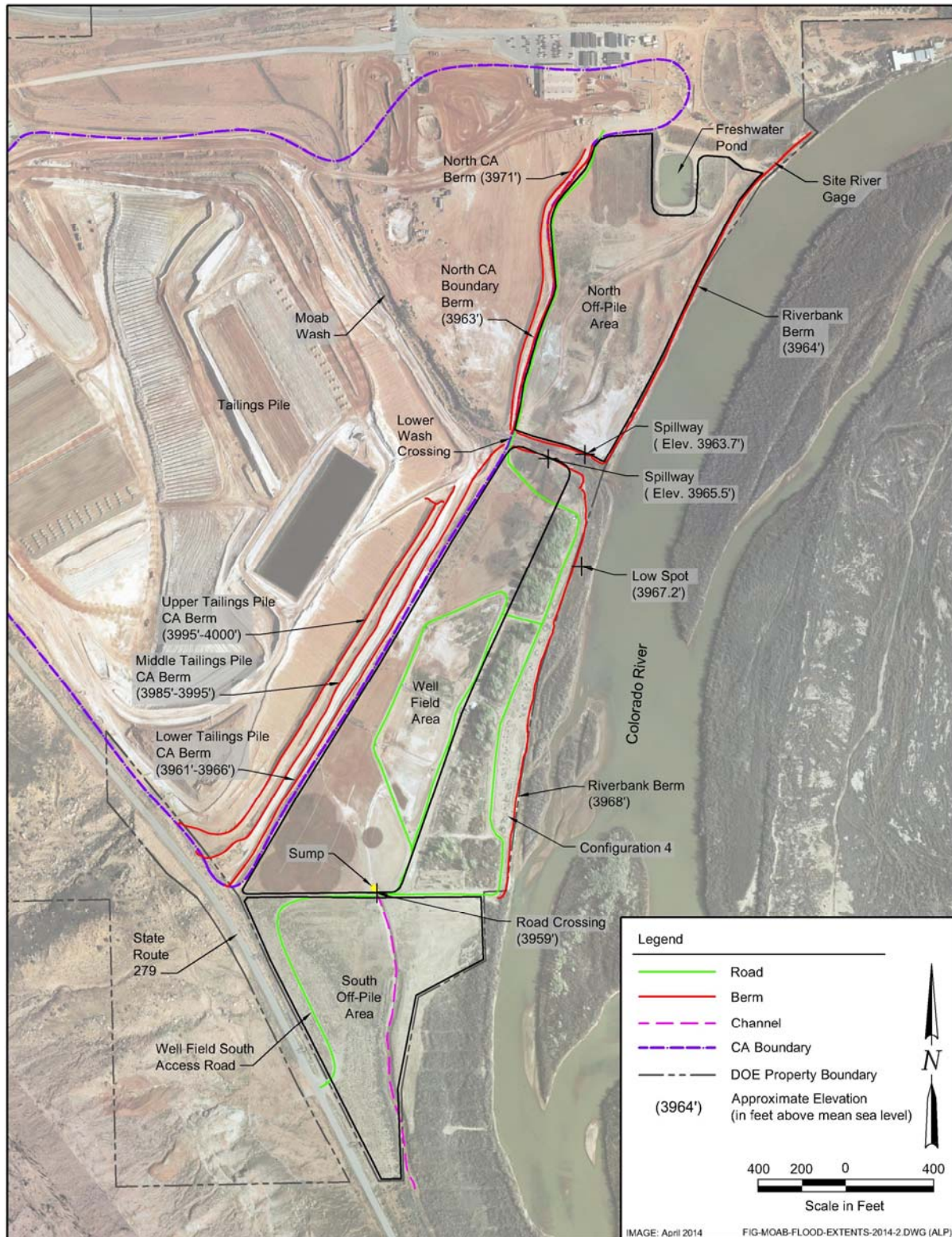


Figure 1. Moab Site Features and On-site Berm Elevations



### 1.3 Recent Site Flooding

Before 2014, the most recent above-average runoff year was 2011. Site flooding during that year is described in the *Moab UMTRA Project 2011 Flood Response Summary* (DOE-EM/GJTAC2007).

Figure 2 shows the snow water equivalent for the Cisco gage in 2011 and 2014, and Figure 3 is a hydrograph showing runoff for these two years. Figure 2 was prepared using the Colorado Basin River Forecast Center website, and Figure 3 was prepared using the USGS National Water Information System: Web Interface for Colorado River Cisco Gaging Station website. The URLs for these websites are listed in Section 6.0.

Since the 2011 flood, several areas of the site were contoured. Portions of the north off-pile area (also referred to as boneyard area) were contoured to allow high river water to gradually inundate the area and reduce the velocity. An existing channel through the south off-pile area was deepened in 2012 and extended to the southern boundary of the well field area (Figure 1).

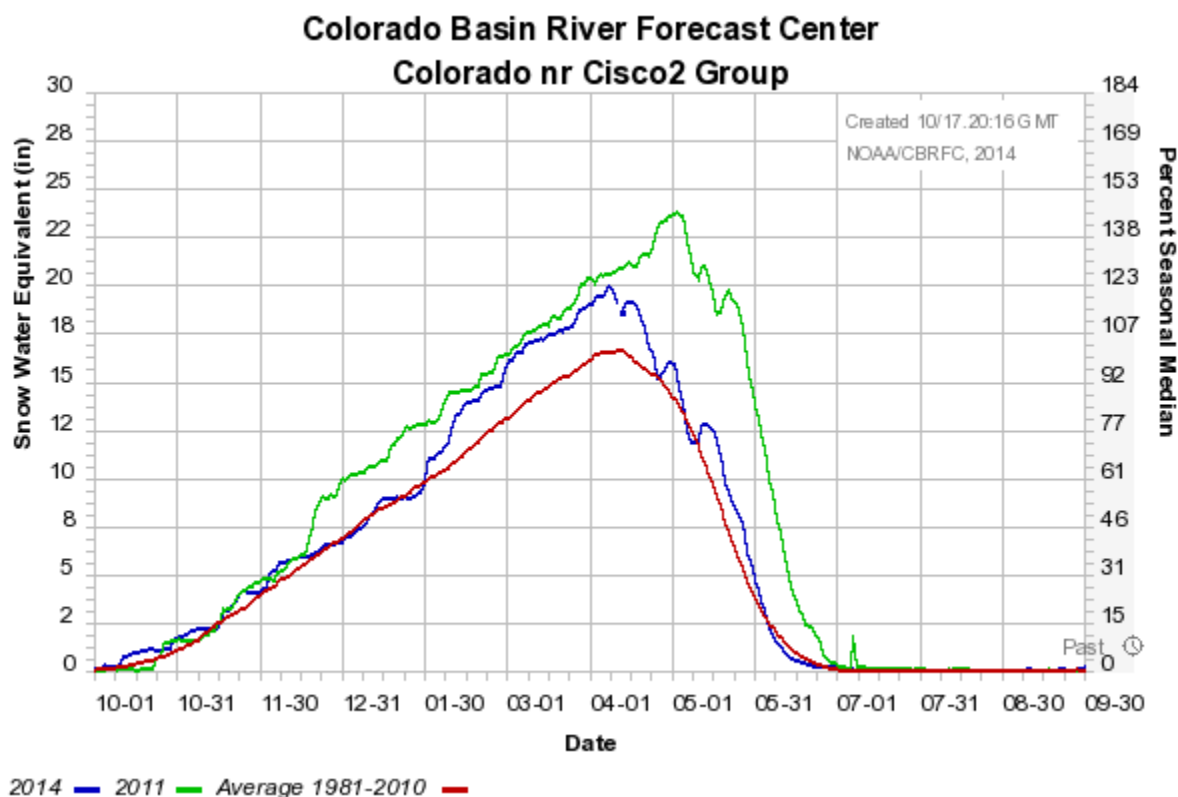


Figure 2. Snow Water Equivalent for the Cisco Gage in 2011 and 2014

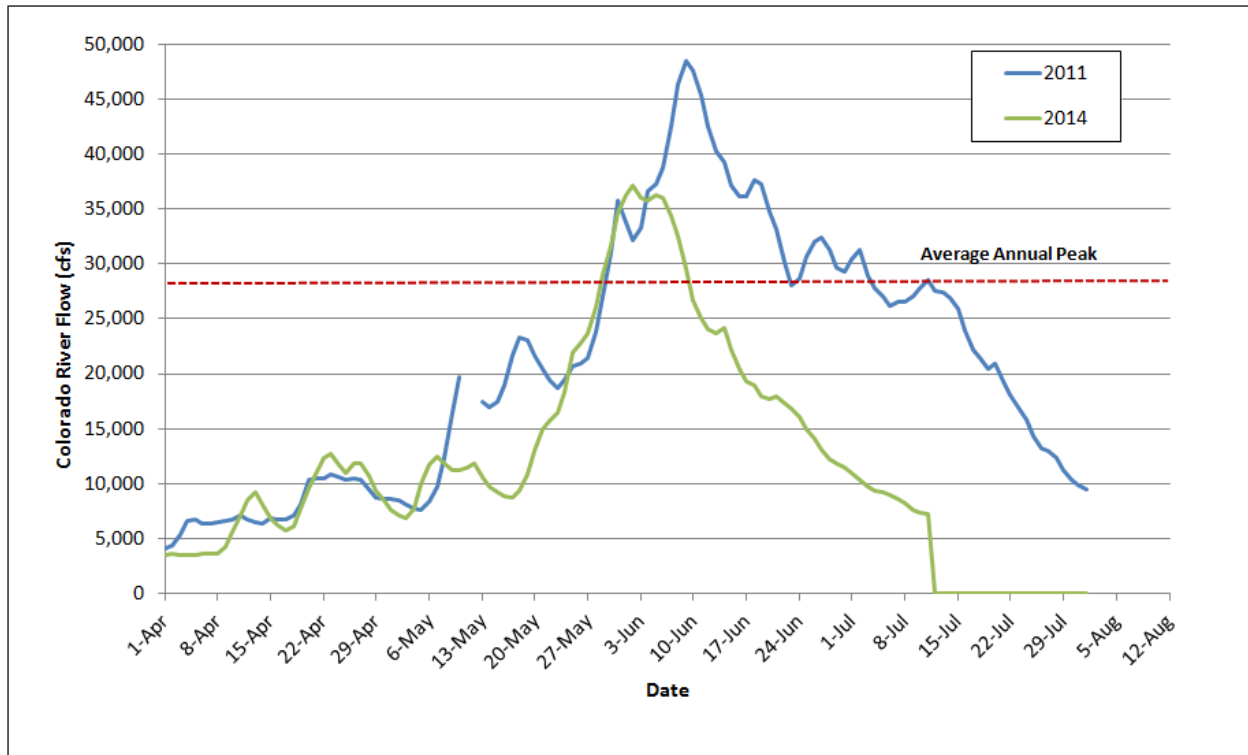


Figure 3. Hydrograph of Runoff in 2011 and 2014

## 2.0 Pre-flood Actions through May 21

In early February 2014, Ground Water Program personnel began monitoring the snowpack in the Rocky Mountains when it appeared to have the potential to result in above-average river flows. Personnel monitored the websites listed in Section 6.0. During April and May, preparations for potential flooding were completed as the snowpack increased in the Upper Colorado River Basin. Updates on snowpack and forecasted river flow were distributed to key RAC, TAC, and U.S. Department of Energy (DOE) personnel, and the Colorado River surface water elevation at the site river gage was recorded on a daily basis beginning on May 6.

### 2.1 Observations

In late April, the Upper Colorado River Basin snow water equivalent was 110 percent of average, and the river flow was between 9,690 and 13,000 cfs (3,956.0 to 3,957.2 ft above mean sea level [amsl]). From May 1 to May 21, the snow water equivalent decreased to nearly 90 percent of average, and the river flow was between 6,930 and 15,300 cfs (3,955.5 to 3,958.0 ft amsl).

Ground water began to daylight in a low-lying area just north of the Moab Wash in early May, when the river flow was approximately 12,300 cfs (3,956.9 ft amsl). After a storm on May 11, up to 2 feet of the bed of the Moab Wash was eroded. As a result, Colorado River water inundated the lower reach of Moab Wash much sooner than previously seen. Figure 4 is a hydrograph showing the Cisco gage flow from April 24 to May 21.

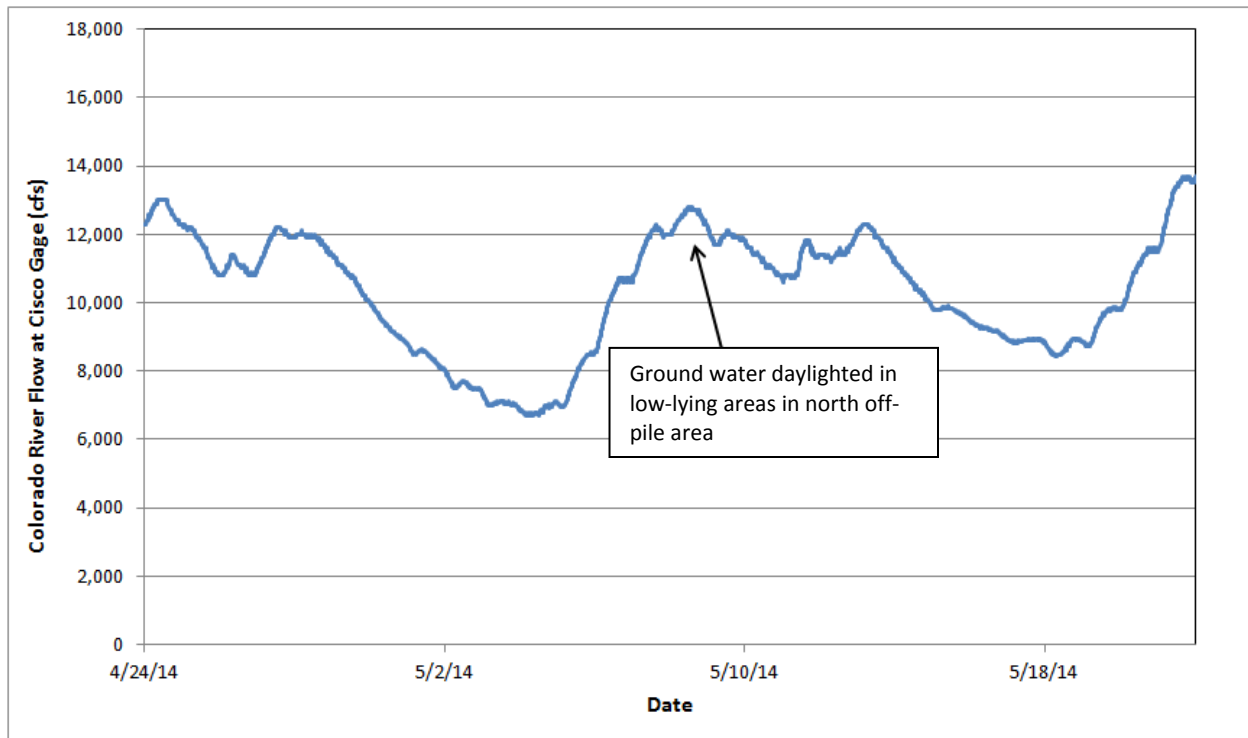


Figure 4. Cisco Gage Hydrograph from April 24 to May 21

## 2.2 Actions Completed

On April 14, in anticipation of having ponded water on site, the TAC installed a sump at the southern end of the well field area to facilitate removal of the water.

New flood elevation maps were created with topographic data from April 2014. These maps were included in the updated *Flood Mitigation Plan* issued in early May. A web page was added to the Project website about the flood potential at the site for 2014.

Rather than removing irrigation piping as stated in the *Flood Mitigation Plan*, the TAC installed large rebar staples over all of the aboveground irrigation piping to protect it from shifting in floodwater.

Parameters and water levels recorded from the Configuration (CF) 4 observation wells indicated a freshwater lens had formed within the aquifer beneath the well field. As a result, the freshwater injection system was shut down on May 13.

TAC Ground Water, Field Management, Safety and Health, and Quality Assurance staff met to discuss the Colorado River predicted flows for the week of May 26 and the associated actions presented in the *Flood Mitigation Plan*. The predicted flow was 25,000 cfs at that time. An electrical subcontractor was scheduled to perform work in late May.

The TAC Hydrogeologist spoke with the Colorado Basin River Forecast Center Forecaster, who stated there would be a planned release of reservoir water on the Gunnison River. If the timing of the release coincided with the timing of the natural peak, the forecaster believed the Cisco gaging station would reach 38,000 cfs.

Table 1 summarizes the actions completed during the pre-flood period.

Table 1. Pre-flood Actions

Action	River Flow (cfs)	On-site River Elevation (ft amsl)	Date Completed
Installed sump in well field area	9,240	3,956.3	4/14/14
Stapled aboveground irrigation pipe	9,290	3,956.2	4/30/14
Distributed revised copy of <i>Flood Mitigation Plan</i>	NA	NA	5/5/14
Added web page on flooding to Project website	NA	NA	5/7/14
Shut down freshwater injection	12,000	3,956.9	5/13/14
Held TAC meeting on flood preparations	13,400	3,957.9	5/21/14

### 3.0 Flood Actions May 22 to June 27

#### 3.1 Observations

By May 22, when the river flow was 15,200 cfs (3958.0 ft amsl), water had backed about halfway up the Moab Wash to the lower crossing, and the river exceeded its bank and began to inundate the north off-pile area (Figure 5). By May 27, the river flow was 22,600 cfs, most of the area was flooded, and the access road was closed.

The release of water at Crystal Reservoir on the Gunnison River occurred from May 24 to June 7, which coincided with the peak flow in the Upper Colorado River Basin. The combination of the release and the peak flow timing contributed to the above-average spring flow of 2014.

On May 30, when the river flow was 28,100 cfs (3,962.8 ft amsl) (Figure 6), the wash lower crossing flooded.

On June 3, when the river flow was 37,200 cfs (3,964.9 amsl) (Figure 7), water began to flow northwest through the drainage channel and eventually flooded nearly all of the well field area. The depth of the water varied from a few inches to nearly 3.5 ft on the western side near the Contamination Area (CA) boundary. Based on the elevation of the channel, water was expected to flow through to the well field area at 25,000 cfs. There was likely debris and/or vegetation blocking the channel south of the DOE property boundary.

Later on June 3, when the river peaked at 37,500 cfs (3,964.7 ft amsl), a nominal amount of water flowed over the Moab Wash southern berm spillway and across the nearby well field access road. During inspection of accessible berms, TAC staff identified a fracture in the southern berm of the wash. The fracture was approximately 20 ft long and several inches deep.

By June 4, the river had receded below the spillway. Some floodwater seeped under sandbags that were placed on the southern side of the Moab Wash lower crossing and collected in the well field area.





Figure 5. Floodwater on Site at 15,000 cfs



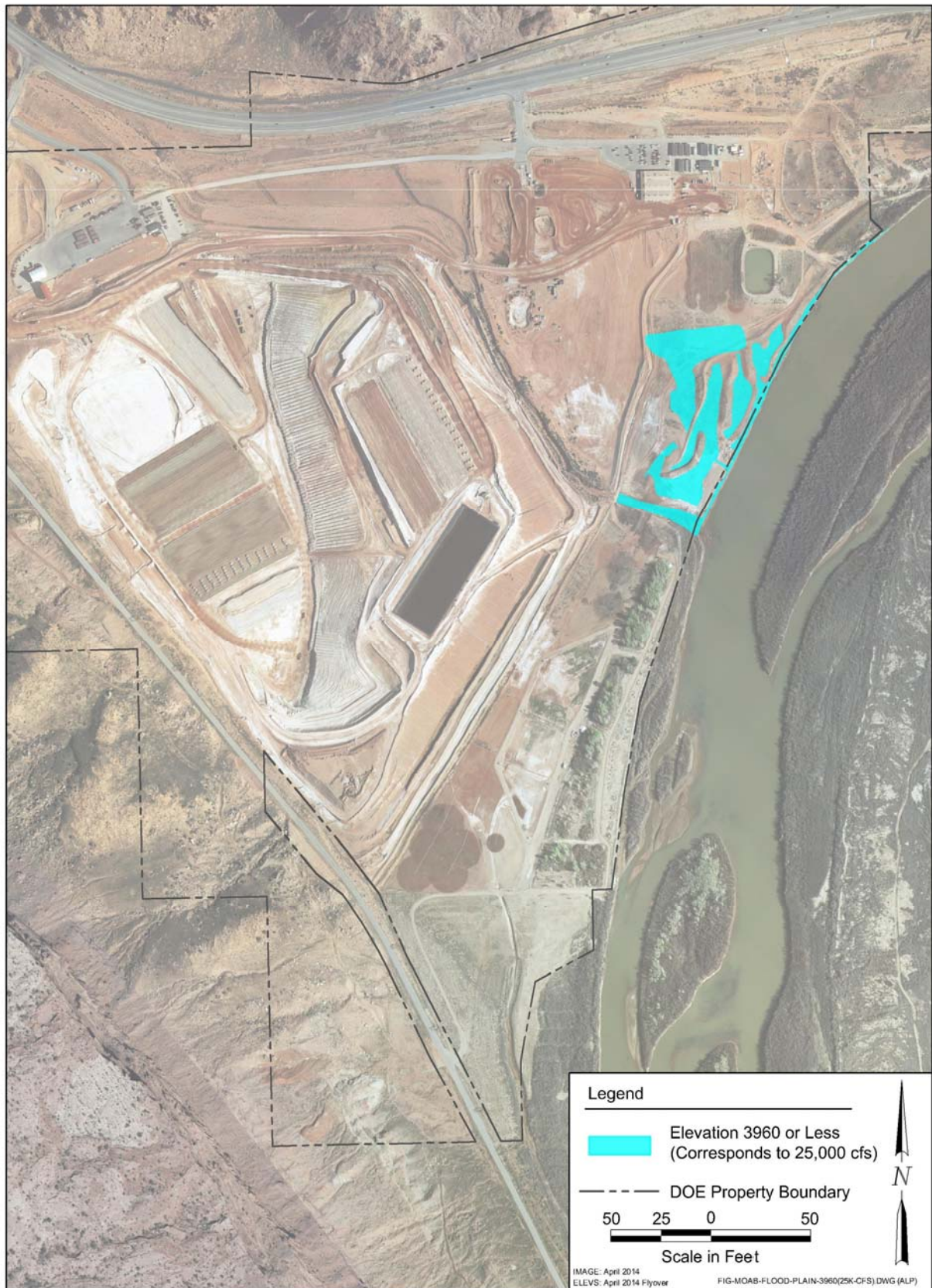


Figure 6. Floodwater on Site at 25,000 cfs



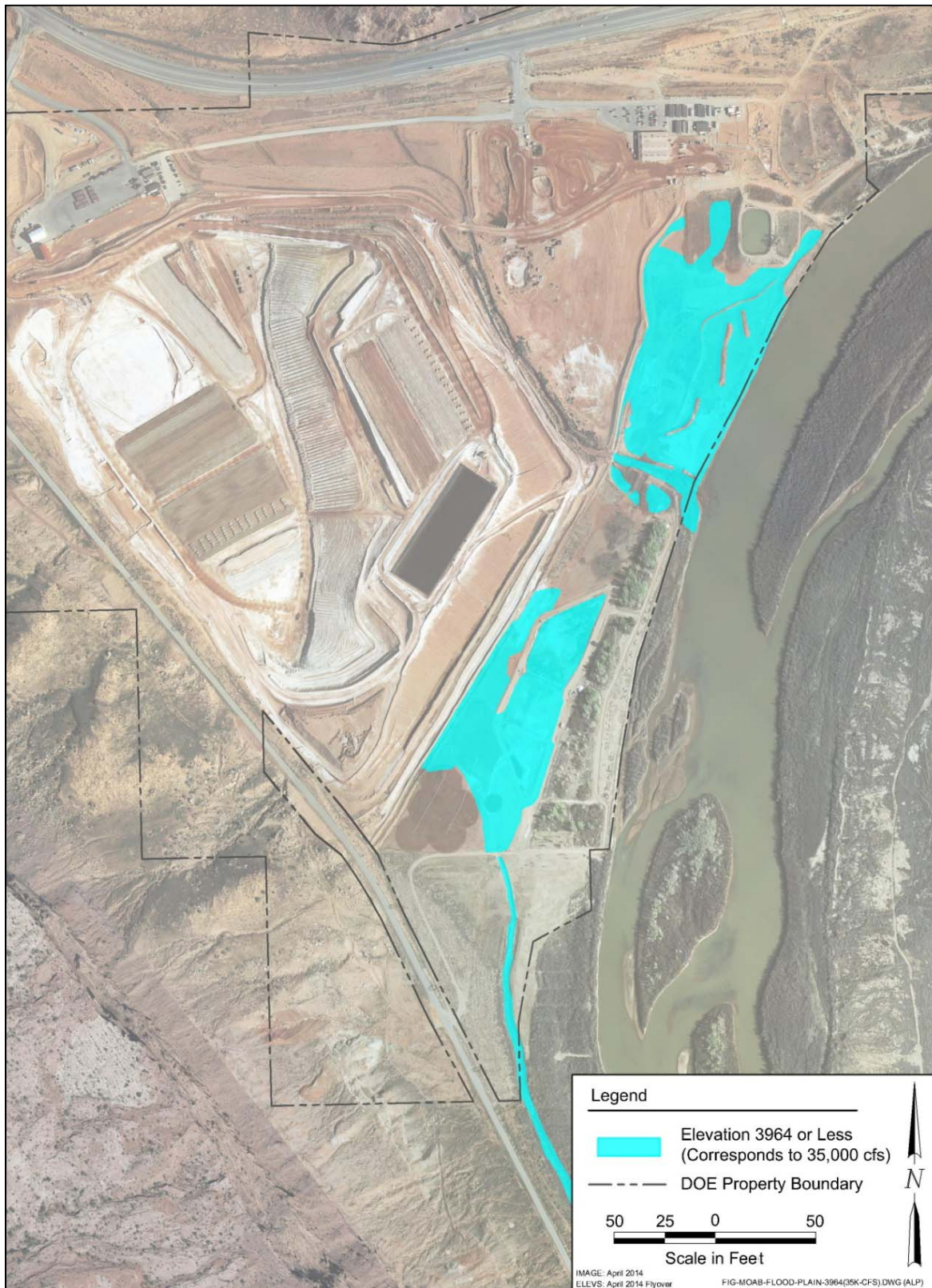


Figure 7. Floodwater on Site at 35,000 cfs



On June 8, water stopped actively flowing into the drainage channel, when the river flow was 34,500 cfs (3,963.8 ft amsl). Water continued to enter the north off-pile area until June 8. Most of the water flowed in near a low spot on the riverbank just southeast of the freshwater pond.

On June 27, the north off-pile area was disconnected from the river, when the river flow was 14,500 cfs (3,958.3 ft amsl). The flood period was considered over at this time. Figure 8 is a hydrograph showing the Cisco gage flow from May 22 to June 27. Appendix A contains photos of the flooding that occurred on site.

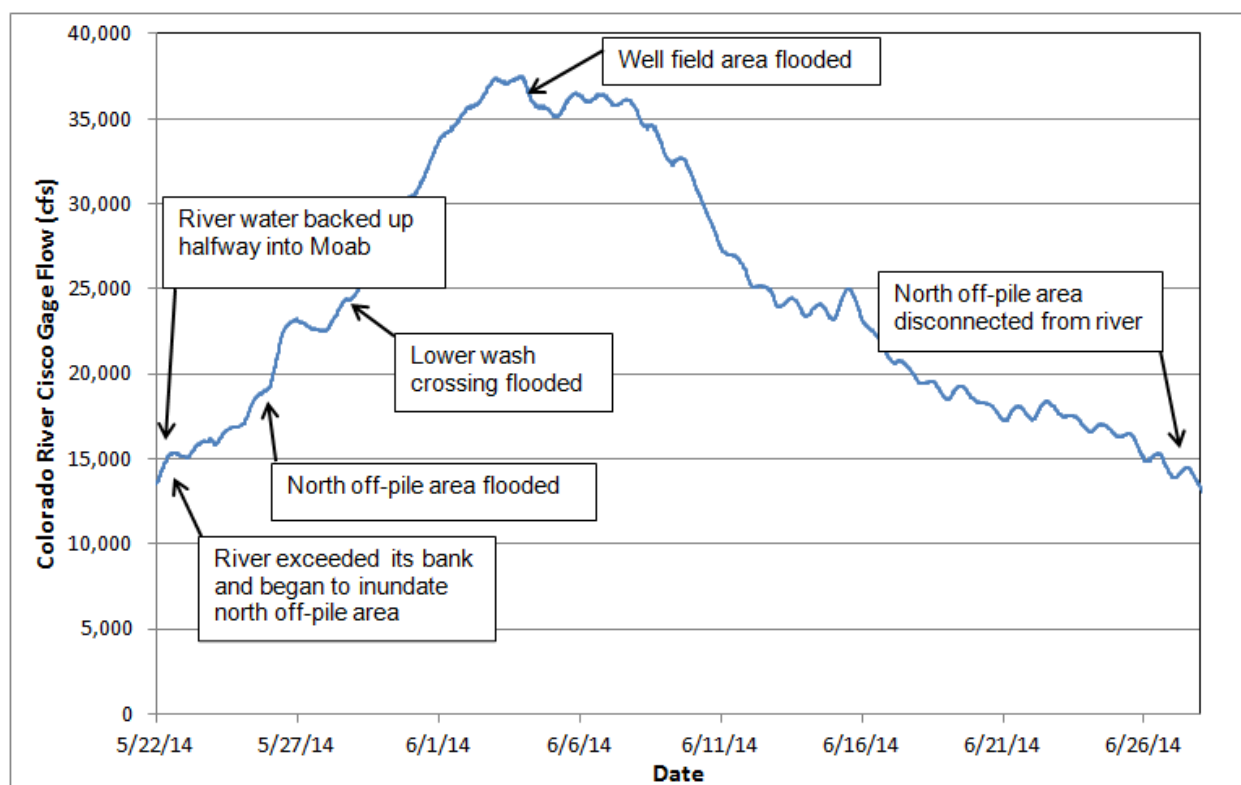


Figure 8. Cisco Gage Hydrograph from May 22 to June 27

### 3.2 Actions Completed

As the river flooded the site, the following actions outlined in the *Flood Mitigation Plan* were completed.

On May 27, the extraction wells were shut down, and the variable frequency drives (VFDs) were removed from each well. A 25,000-cfs walkthrough was attended by TAC, RAC, and DOE personnel.

On May 28, the electrical subcontractor removed the vault space heaters and transformers associated with the injection wells and the transformers in the well field area. Flowmeter plates and pressure transducers were pulled from the injection, extraction, and observation wells. Also on May 28, sandbags were placed on the southern side of the Moab Wash lower crossing, signs along the river and a site road were removed, and a lighted sign was added to the riverbank near the freshwater pond to alert boaters of underwater hazards.

In addition, the river rafting companies were notified of potential underwater hazards on site. The RAC removed the air monitoring station near well vault 0815.

On June 2, a meeting was held with pertinent TAC, RAC, and DOE personnel to determine what actions were necessary as the flow reached above 35,000 cfs. Daily emails were also sent to alert personnel of the river flow, elevation of the site gage, and changes to the flooded areas on site.

On June 3, TAC staff placed soil behind the Moab Wash southern berm fracture to reinforce the area.

On June 17, the Grand County Mosquito Control Coordinator visited the site to identify areas of potential concern about mosquito larva. Also, Utah DNR visited the site to assess the ponded areas. They decided to return after the ponded water had separated from the main river channel.

On June 18, pumping floodwater from the sump in the well field area was initiated using a generator and the 3-inch (in.) pump normally used for surface water diversion. This water was pumped into nearby tree plots 24 hours a day Monday through Thursday and shut down on Friday at the end of the shift. In addition, a 2-in., gasoline-powered pump was placed south of well PW02 to pump water into a tree plot to the east.

In late June, a rented 3-in., gasoline-powered pump was put into service to water the tree plots, replacing the TAC-owned, 2-in. pump. The pumping rate from the well field area was about 500,000 gallons per day, using both the gas-powered and electric 3-in. pumps. Ponded water was pumped for approximately 8 days, for a total volume of 4 million gallons. The 2-in. pump was relocated to the north off-pile area to help drain ponded water.

Table 2 summarizes the actions completed during site flooding.

*Table 2. Flood Actions*

Action	River Flow (cfs)	On-site River Elevation (ft amsl)	Date Completed
Walkthrough with RAC, TAC, and DOE before 25,000 cfs	22,600	3,961.0	5/27/14
Shut down extraction wells; removed VFDs			
Tied down stockpiled irrigation pipe			
Removed injection well vault space heaters and transformers and well field area transformers	24,200	3,961.1	5/28/14
Removed flowmeter plates/transducer			
Placed sandbags at the Moab Wash lower crossing			
Removed signs along river and a site road			
Added warning sign to riverbank for boaters and notified boating companies of underwater hazards			
Removed air monitoring station from well field	36,100	3,964.4	6/2/14
Met with RAC, TAC, and DOE at 35,000+ cfs			
Reinforced Moab Wash southern berm fracture	37,500	3,964.7	6/3/14
Site visited by County Mosquito Control Coordinator	20,800	3,960.6	6/17/14
Utah DNR viewed on-site ponded water			
Began pumping ponded water from well field area to tree plots	19,400	3,960.2	6/18/14
Added 3-in. pump to assist with well field area floodwater removal	15,300	3,958.0	6/26/14

## 4.0 Post-flood Actions June 28 to September 4

### 4.1 Observations

The roads connecting the Moab Wash lower crossing became passable in late June as the soil started to dry. Several areas of ponded water remained in the north off-pile area until mid-July.

The culvert under the access road at the southern end of the well field area became exposed on June 18, indicating the ponded water was receding. By July 8, most of the floodwater in the well field area had collected into the drainage channel, and by mid-July, the drainage channel was dry.

The north off-pile area contained only a few pockets of floodwater through mid-July, and most of the water was gone by the end of July.

Up to 20 in. of silt were deposited in portions of the north off-pile area; however, in most areas, existing vegetation survived. From the observed grain size of the deposits, the floodwater velocity was assumed to have been low enough neither to erode soils nor deposit gravels or cobbles.

Although floodwater was almost gone by mid-July, the low-lying area in the southwestern portion of the well field remained submerged due to monsoonal storms in late July/early August. This location was dry enough for a gamma flood scan by early September.

Figure 9 is a hydrograph showing the Cisco gage flow from June 28 to September 4. Appendix B contains photos of the post-flood period.

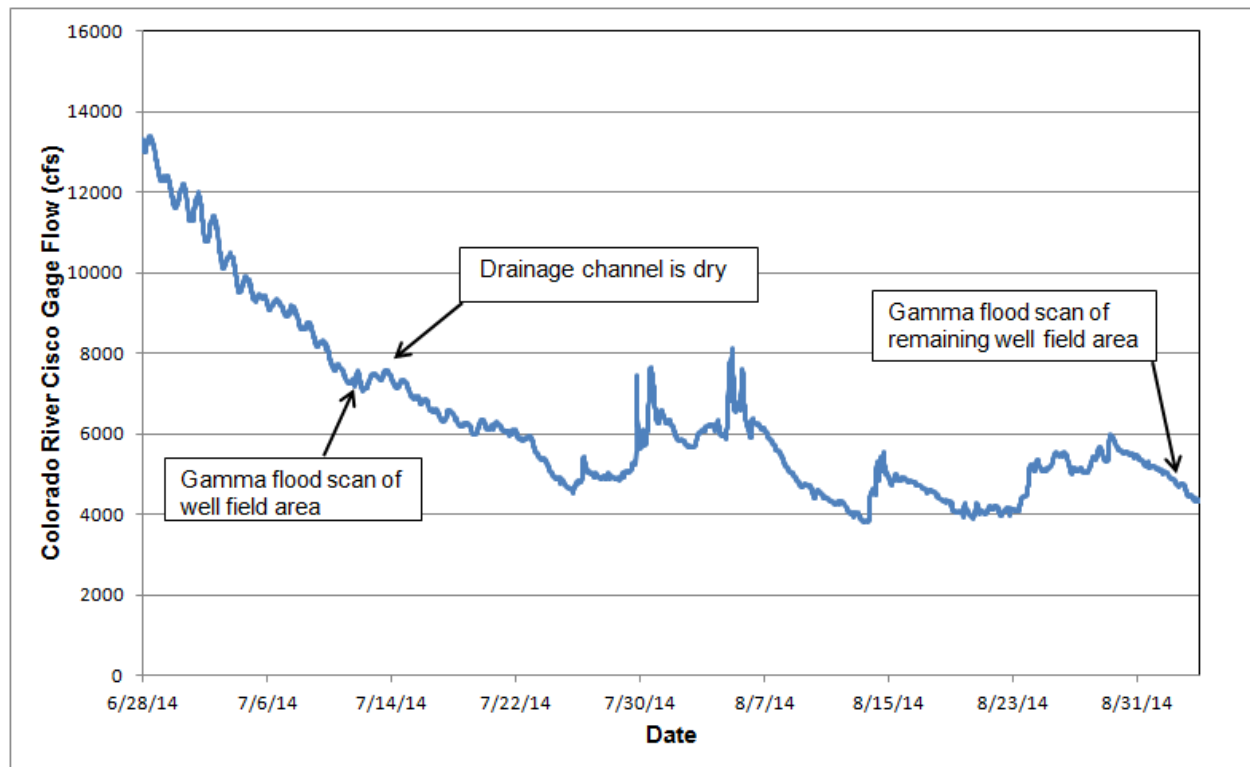


Figure 9. Cisco Gage Hydrograph from June 28 to September 4

## 4.2 Actions Completed

Post-flood actions focused on removing ponded water, restarting well field operations, and conducting radiological scans as areas dried out.

On July 1, TAC staff removed the sandbags from the Moab Wash lower crossing and performed a gamma survey of the crossing. There were no gamma exposure-rate readings exceeding 30 percent the background 350 to 400 counts per second (cps). A composite soil sample was collected from each side of the crossing and analyzed utilizing the Opposed Crystal System (OCS). The sample analysis indicated 3.1 picocuries per gram (pCi/g) of radium-226 (Ra-226) in the soil. This value was under the 5.8 pCi/g Ra-226 surface cleanup criteria requiring disposal in the CA. The RAC removed the soil from the crossing, and the connecting road and crossing were reopened.

On July 7, a gamma scan/global positioning system (GS/GPS) flood scan was performed along the CA boundary north and south of the Moab Wash to determine if any contamination had been transported outside the CA. A handheld sodium iodide gamma scintillometer was passed over the area two to three times to ensure adequate coverage. Readings of 700 to 900 cps were found in the soil along the 4- and 6-in. extraction lines. One soil sample collected in the area measured 2.3 pCi/g Ra-226. Based on this analytical result, the elevated gamma readings were attributed to emanation from the tailings pile. Appendix C contains the radiological survey documentation. The prolonged presence of ponded water from rain events prevented a portion of the well field from being surveyed.

On July 10, freshwater injection was restarted into all 10 of the CF4 wells at a rate of approximately 30 gallons per minute.

On July 14 and 16, Utah DNR personnel visited the site to look for endangered fish in the ponded water. They used a seine to identify fish species that were collected; no endangered fish were present in the isolated pools. Attachment 1 contains a letter written to the Project from Utah DNR.

On July 15, the electrical subcontractor reinstalled the VFDs, transformers, and electrical connections for the extraction wells. All of the associated electrical panels were inspected, labeled, and tested. Locks and tags were removed from the main disconnect, and power was restored to the well pumps.

On July 30, the RAC replaced the air monitoring station near vault 0815 in the well field area.

On August 7, TAC staff assessed the thickness of silt deposited in the north off-pile area and removed silt from the roadways.

On September 4, a GS/GPS flood scan was performed along the remainder of the CA boundary in the well field area. Areas of elevated gamma readings were noted along the fence line, and composite soil samples were collected and analyzed using the OCS. A sample from the western end measured 7.5 pCi/g for Ra-226. Fifteen individual samples were collected in this area to delineate the extent of contamination.

Fourteen samples ranged from 1.1 to 5.5 pCi/g Ra-226, which did not exceed the 5.8 pCi/g surface cleanup criteria. One sample measured 10.2 pCi/g Ra-226, and that area was marked for cleanup. On September 23, the area with elevated Ra-226 was removed and placed back in the CA. A verification composite sample of the area was collected and analyzed for Ra-226 using the OCS. The result was 3.4 pCi/g so no further action was needed.

Table 3 summarizes actions completed post-flood.

*Table 3. Post-flood Actions*

<b>Action</b>	<b>River Flow (cfs)</b>	<b>On-site River Elevation (ft amsl)</b>	<b>Date Completed</b>
Removed sandbags from the Moab Wash lower crossing and scanned the crossing	11,900	3,957.5	7/1/14
Performed gamma flood scan along CA boundary	9,080	3,956.2	7/7/14
Restarted freshwater injection operations in CF4	7,590	3,955.3	7/10/14
Utah DNR sampled ponded water in the north off-pile area for endangered fish species	7,240	3,955.3	7/14/14
Reinstalled VFDs and transformers; restarted extraction operations	6,900	3,954.0	7/15/14
Utah DNR sampled ponded water in well field area for endangered fish species	6,590	3,954.0	7/16/14
RAC replaced air monitoring station near well vault 0815	6,310	3,954.7	7/30/14
Assessed thickness of deposited silt; removed silt from roadways	NA	NA	8/7/14
Performed GS/GPS flood scan along CA boundary on the southern end of well field area	4,400	3,954.1	9/4/14
Removed contaminated soil from well field area and placed it back in CA	NA	NA	9/23/14

## 5.0 Lessons Learned

As flooding occurs on site, personnel take the opportunity to learn from the experience so the *Flood Mitigation Plan* can be revised to include any updates that may help protect property and the environment. The following items were noted during the 2014 flood event.

- Site elevation versus river flow is not always the most accurate method of determining when and where the site will flood. The well field area elevation suggests that when the river flow reaches 25,000 cfs, this area will flood from the river backing up in the drainage channel. In 2014, the well field area did not flood until 37,200 cfs; however, once floodwater entered this area, it continued to flow for another 2 days. This suggests that something, such as plant debris or soil, was initially blocking the channel and preventing the water from flowing in. Inspection of the drainage channel south of the property boundary should be included in the flood preparations.
- After the river peaked, the ponded water in the well field area had to be pumped out; the water did not flow back through the channel as expected. Pumps should be on site and ready to remove water immediately following the peak flow.
- Due to the predicted peak flow, flooding in the well field area could have been prevented by placing sandbags in the Moab Wash southern berm spillway and in the drainage channel. An evaluation should be made during flood preparations to determine if additional actions should be taken to prevent flooding of the well field area.

- Although most of the accessible signage was removed before site flooding, removing all of the signs before the start of flooding should be added to the action list.
- Some of the low-lying observation wells in the north off-pile area were buried by silt during the flooding. It would be beneficial to either extend the well casing or install a taller marker so the wells can be easily located after flooding.
- Because the injection well vaults did not flood this year, it might be more cost-effective to remove the transformers and vault heaters in this area at a higher flow.
- Similarly, the river flow action level for the removal of the well field area transformers should be reconsidered because the floodwater in 2014 did not impact them.
- The berms along the Moab Wash should be inspected more frequently before and during flood events and reinforced as appropriate.

## 6.0 Websites

TAC staff monitored and/or used information from the following websites to help prepare for and respond to the 2014 flood.

Colorado SNOTEL Snow Water Equivalent Update Graph

<http://www.wcc.nrcs.usda.gov/cgi-bin/snowup-graph.pl?state=CO>

Colorado River Basin Water Year Comparison Graph

[http://www.cpatchcojr.com/cgi-bin/work/get\\_basin.cgi](http://www.cpatchcojr.com/cgi-bin/work/get_basin.cgi)

National Oceanic and Atmospheric Administration, Colorado River Basin Forecast Center, Cisco Hydrograph

<http://www.cbrfc.noaa.gov/river/station/flowplot/flowplot.cgi?CLRU1>

National Weather Service Water Resources Outlook

<http://wateroutlook.nwrhc.noaa.gov/point/ranking>

Natural Resources Conservation Service Colorado Home Page

[http://www.co.nrcs.usda.gov/snow/snow/watershed/current/daily/maps\\_graphs/index.html](http://www.co.nrcs.usda.gov/snow/snow/watershed/current/daily/maps_graphs/index.html)

SNOTEL Basin Snow Water Equivalent Projection Maps with Selectable Future Conditions

[http://www.co.nrcs.usda.gov/snow/snow/watershed/current/daily/maps\\_graphs/swe\\_projections\\_05.html](http://www.co.nrcs.usda.gov/snow/snow/watershed/current/daily/maps_graphs/swe_projections_05.html)

U.S. Geological Survey National Water Information System: Web Interface for Colorado River Cisco Gaging Station

[http://waterdata.usgs.gov/ut/nwis/uv/?site\\_no=09180500&agency\\_cd=USGS](http://waterdata.usgs.gov/ut/nwis/uv/?site_no=09180500&agency_cd=USGS)

## 7.0 References

DOE (U.S. Department of Energy), *Moab UMTRA Project 2011 Flood Response Summary* (DOE-EM/GJTAC2007).

DOE (U.S. Department of Energy), *Moab UMTRA Project Flood Mitigation Plan* (DOE-EM/GJTAC1640).

## **Appendix A.**

### **Flood Photos**



## Appendix A. Flood Photos

May 22, 2014  
15,200 cfs; 3958.38 ft amsl



*Photo A-1. River Water Backing Up into Lower Reach of Moab Wash*



*Photo A-2. Floodwater Entering North Off-pile Area*

## Appendix A. Flood Photos (continued)

May 27, 2014  
23,000 cfs; 3961.0 ft amsl



*Photo A-3. River Water Backed Up into Lower Reach of Moab Wash*



*Photo A-4. North Off-pile Area from Top of Tailings Pile*

## Appendix A. Flood Photos (continued)

June 1, 2014  
34,300 cfs; 3964.1 ft amsl



*Photo A-5. North Off-pile Area*



*Photo A-6. Moab Wash Lower Crossing*



## Appendix A. Flood Photos (continued)



*Photo A-7. Moab Wash Looking East from Southern Bank of Wash*

**June 3, 2014**  
**37,200 cfs; 3964.9 ft amsl**



*Photo A-8. Drainage Channel through South Off-pile Area*

## Appendix A. Flood Photos (continued)



*Photo A-9. Moab Wash Lower Crossing*



*Photo A-10. Ponded Water Just South of Moab Wash*

## Appendix A. Flood Photos (continued)

June 4, 2014  
36,100 cfs; 3964.8 ft amsl



*Photo A-11. North Off-pile Area from Top of Tailings Pile*



*Photo A-12. Well Field Area from Top of Tailings Pile*



## Appendix A. Flood Photos (continued)



*Photo A-13. Floodwater on Road in Well Field Area*

**June 9, 2014**  
**32,400 cfs; 3963.7 ft amsl**



*Photo A-14. Well Field Area from State Route 279*



## Appendix A. Flood Photos (continued)



*Photo A-15. Drainage Channel through South Off-pile Area*

**June 11, 2014**  
**27,000 cfs; 3962.3 ft amsl**



*Photo A-16. North Off-pile Area and the Moab Wash from Tailings Pile*

## Appendix A. Flood Photos (continued)



*Photo A-17. Well Field Area from Top of Tailings Pile*

**June 17, 2014**  
**20,800 cfs; 3960.1 ft amsl**



*Photo A-18. North Off-pile Area from Top of Tailings Pile*

## Appendix A. Flood Photos (continued)



*Photo A-19. Well Field Area from Top of Tailings Pile*



*Photo A-20. Well Field Area from State Route 279*

**Appendix B.**  
**Post-flood Photos**



## Appendix B. Post-flood Photos

**July 1, 2014**  
**11,600 cfs; 3965.7 ft amsl**



*Photo B-1. Floodwater in North Off-pile Area*



*Photo B-2. Floodwater in Well Field Area from State Route 279*

## Appendix B. Post-flood Photos (continued)

July 10, 2014  
7,610 cfs; 3955.3 ft amsl



*Photo B-3. Nearly Dry North Off-pile Area*



*Photo B-4. Well Field Area Floodwater from State Route 279*

## Appendix B. Post-flood Photos (continued)

July 17, 2014  
6,380 cfs; 3954.7 ft amsl



*Photo B-5. Well Field Floodwater from State Route 279*



**Appendix C.**  
**Post-flood Radiological Survey Results**

## Appendix C. Post-flood Radiological Survey Results

### DAILY LOG

PROPERTY ID NUMBER – Moab Project Site	PROPERTY ADDRESS – 2021 North Highway 191
SURVEY DATES – July 7, 2014 and September 4, 2014	
TECHNICIANS – Colunga	

### INSTRUMENTATION

INSTRUMENT NUMBER	INSTRUMENT TYPE	CALIBRATION EXPIRES	COMMENTS
9938	Crutch	08-25-14	OK 07-07-14
9930	Crutch	08-04-15	OK 09-04-14

### AREA INFORMATION

<p>July 7, 2014</p> <p>A flood gamma scan was performed for the perimeter of the Contaminated Area portion of the Project Site adjacent to the soil berms to determine if any contamination had been transported from the CA in to the newly remediated areas due to the summer flood event. Two to three passes (24 to 36 feet) were scanned to ensure adequate coverage. After the survey was completed, the data was down loaded and processed with Gamma View software. A map was generated displaying the gamma flood information for the scan.</p> <p>After a review of the data it was determined that unusually high gamma readings were found in Configuration 5 where the 4 and 6 inch extraction water lines go up to the evaporation pond on top of the tailings pile.</p> <p>A hand held sodium iodide gamma scintillometer was used to scan the area and readings of 700 to 900 cps (58 to 73 <math>\mu</math>R/h) were found in the soil. One sample was collected in the area. The sample was analyzed for Ra-226 using the Opposed Crystal System and the result was 2.3 pCi/g for the sample. Based on the soil sample result, the elevated gamma readings are due to "shine" and not to contaminated soil.</p> <p>Additional samples will be collected in areas that are still under water and could not be sampled at this time.</p>	
<p>September 4, 2014</p> <p>A GS/GPS gamma flood scan was done for the remainder of the Contamination Area boundary in Config 5. Areas of elevated gamma readings were noted along the fence line and composite soil samples were collected in those areas and analyzed using the Opposed Crystal System. A sample from the west end of the area was 7.5 pCi/g for Ra-226. 15 additional samples were collected in the area to delineate the extent of contamination. 14 samples ranged from 1.1 to 5.5 pCi/g Ra-226 and do not exceed the 5.8 pCi/g for clean up criteria. One sample was 10.2 pCi/g Ra-226 and that area will be marked for clean up.</p>	
SIGNATURE — Ernie Colunga	DATE — September 4, 2014

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## Appendix C. Post-flood Radiological Survey Results (continued)

Property Number	Moab Project Site		Date		8/31/2014 to 9/6/2014					
Moab Stationary Unit		MCB-1								
Location Sample Number	Sample Ticket Number	Sample Depth (inches)	Net Mass (grams)	Net Peak (Counts)	Radium Conc. (pCi/g)	Uranium Conc. (pCi/g)	Gamma Range			Notes
							min	max	avg	
Sample #2	PAB 407	0-6	499.1	642	3.5		700	900		Post Flood Composite Sample
Sample #3	PAB 408	0-6	455.4	749	4.7		750	800		Post Flood Composite Sample
Moab Stationary Unit		MCB-2								
Location Sample Number	Sample Ticket Number	Sample Depth (inches)	Net Mass (grams)	Net Peak (Counts)	Radium Conc. (pCi/g)	Uranium Conc. (pCi/g)	Gamma Range			Notes
							min	max	avg	
Sample #4	PAB 409	0-6	463.3	1042	7.5		400	700		Post Flood Composite Sample
Sample #5	PAB 410	0-6	544.1	738	4.2					Post Flood Sample F150.67 H070
Sample #6	PAB 411	0-6	605.2	426	1.7					Post Flood Sample F160 H070
Sample #7	PAB 412	0-6	539.6	542	2.9					Post Flood Sample G010 H090
Sample #8	PAB 413	0-6	505.8	406	2.1					Post Flood Sample G000 H090
Sample #9	PAB 414	0-6	555.7	892	5.1					Post Flood Sample G000 H080
Sample #10	PAB 415	0-6	568	320	1.2					Post Flood Sample F170 H080
Sample #11	PAB 416	0-6	568.4	736	4.0					Post Flood Sample F150 H060
Sample #12	PAB 417	0-6	599.2	760	3.9					Post Flood Sample F150 H080
Sample #13	PAB 418	0-6	509.9	470	2.6					Post Flood Sample F150 H070
Sample #14	PAB 419	0-6	601.7	323	1.1					Post Flood Sample F140 H070
Sample #15	PAB 420	0-6	537.4	670	3.8					Post Flood Sample F140.67 H060
Sample #16	PAB 421	0-6	582.1	487	2.3					Post Flood Sample F140 H060
Sample #17	PAB 422	0-6	489	358	1.8					Post Flood Sample F130 H060
Sample #18	PAB 423	0-6	516.2	1535	10.2					Post Flood Sample
Sample #19	PAB 424	0-6	552	938	5.5					Post Flood Sample

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## Appendix C. Post-flood Radiological Survey Results (continued)

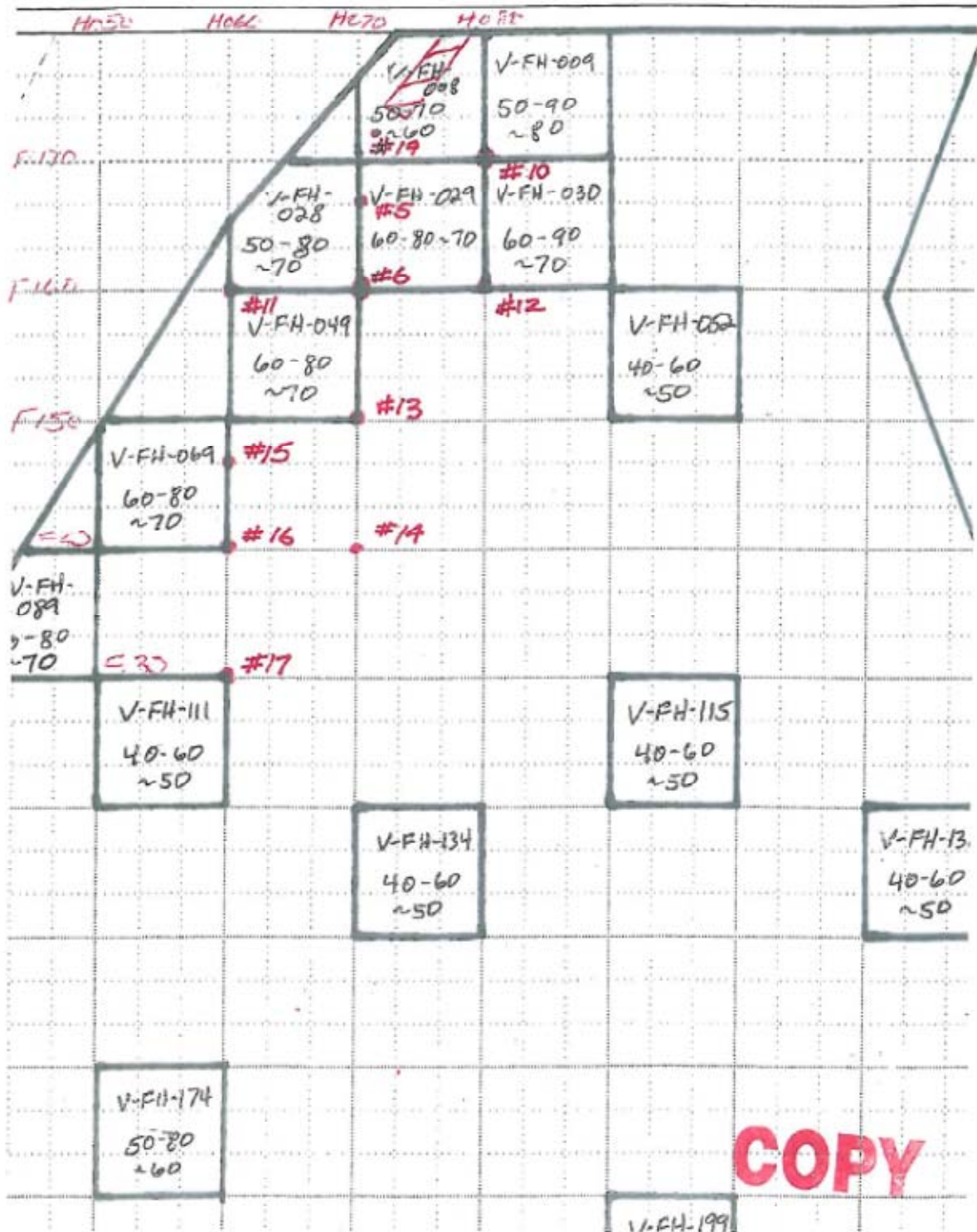


## Appendix C. Post-flood Radiological Survey Results (continued)

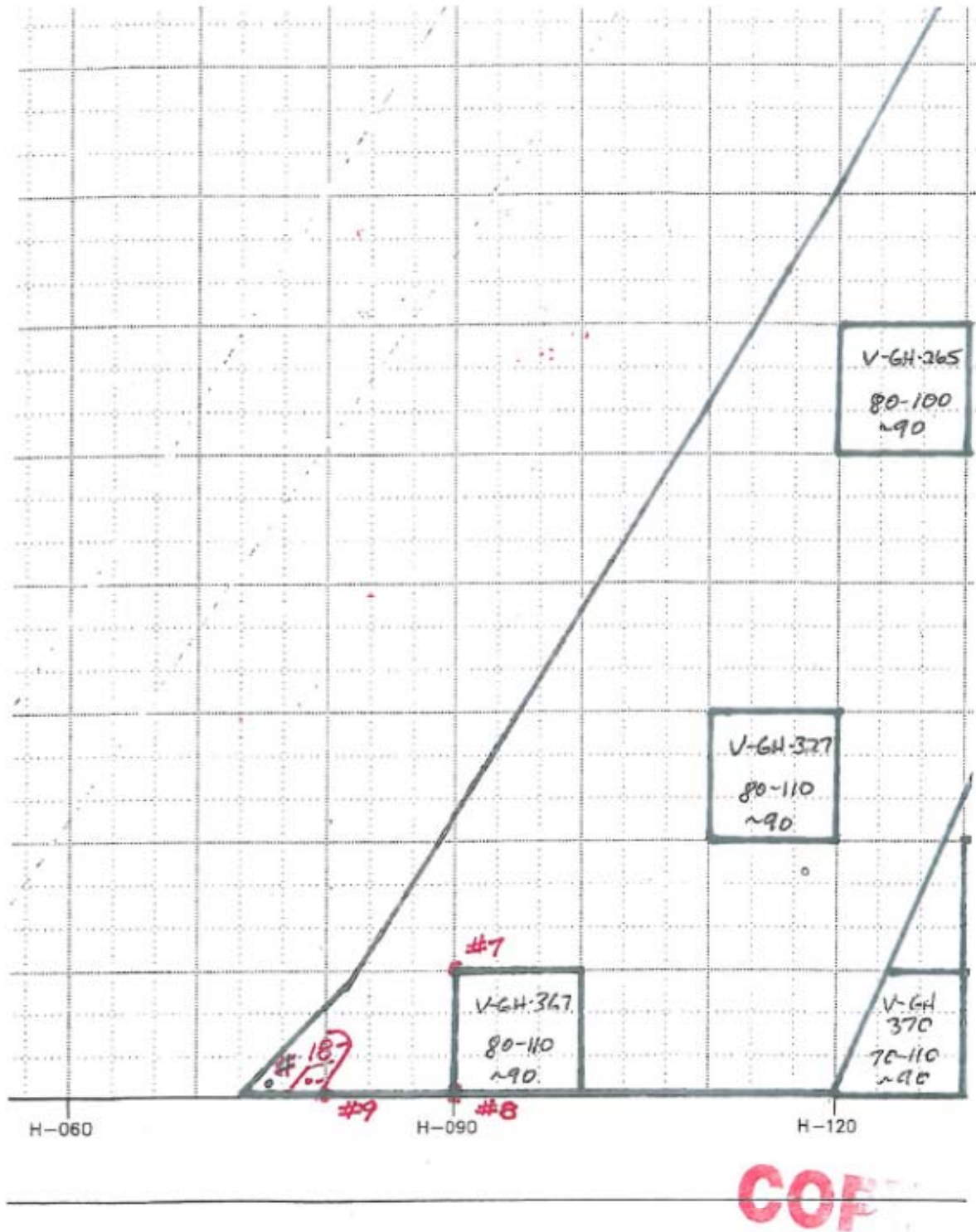




## Appendix C. Post-flood Radiological Survey Results (continued)



## Appendix C. Post-flood Radiological Survey Results (continued)



## Appendix C. Post-flood Radiological Survey Results (continued)

### DAILY LOG

PROPERTY ID NUMBER – Moab Project Site	PROPERTY ADDRESS – 2021 North Highway 191
SURVEY DATES – July 7, 2014 and September 4, 2014	
TECHNICIANS – Colunga	

### INSTRUMENTATION

INSTRUMENT NUMBER	INSTRUMENT TYPE	CALIBRATION EXPIRES	COMMENTS
9938	Crutch	08-25-14	OK 07-07-14
9930	Crutch	08-04-15	OK 09-04-14

### AREA INFORMATION

<p>July 7, 2014</p> <p>A flood gamma scan was performed for the perimeter of the Contaminated Area (CA) portion of the Project Site adjacent to the soil berms to determine if any contamination had been transported from the CA in to the newly remediated areas due to the summer flood event. Two to three passes (24 to 36 feet) were scanned to ensure adequate coverage. After the survey was completed, the data was down loaded and processed with Gamma View software. A map was generated displaying the gamma flood information for the scan.</p> <p>After a review of the data it was determined that unusually high gamma readings were found in Configuration 5 where the 4 and 6 inch extraction water lines go up to the evaporation pond on top of the tailings pile.</p> <p>A hand held sodium iodide gamma scintillometer was used to scan the area and readings of 700 to 900 cps (58 to 73 <math>\mu</math>R/h) were found in the soil. One sample was collected in the area. The sample was analyzed for Ra-226 using the Opposed Crystal System and the result was 2.3 pCi/g for the sample. Based on the soil sample result, the elevated gamma readings are due to "shine" and not to contaminated soil.</p> <p>Additional samples will be collected in areas that are still under water and could not be sampled at this time.</p>	
<p>September 4, 2014</p> <p>A GS/GPS gamma flood scan was done for the remainder of the Contamination Area boundary in Config 5. Areas of elevated gamma readings were noted along the fence line and composite soil samples were collected in those areas and analyzed using the Opposed Crystal System. A sample from the west end of the area was 7.5 pCi/g for Ra-226 . 15 additional samples were collected in the area to delineate the extent of contamination. 14 samples ranged from 1.1 to 5.5 pCi/g Ra-226 and do not exceed the 5.8 pCi/g for clean up criteria. One sample was 10.2 pCi/g Ra-226 and that area will be marked for clean up.</p>	
<p>September 23, 2014</p> <p>The contaminated soil in Config 5 was remediated and placed in the CA. A composite sample of the area was collected and was analyzed for Ra-226 using the Opposed Crystal System and the result was 3.4 pCi/g for the sample. This meets the 5.8 clean-up criteria for the area and no further action is required.</p>	
<p>SIGNATURE — Ernie Colunga </p>	<p>DATE — September 23, 2014</p>

## Appendix C. Post-flood Radiological Survey Results (continued)

PropertyNumber		Moab Project Site				Date: 9/21/2014 to 9/27/2014				
Moab Stationary Unit		MCB-1								
Location Sample Number	Sample Ticket Number	Sample Depth (inches)	Net Mass (grams)	Net Peak (Counts)	Radium Conc. (pCi/g)	Uranium Conc. (pCi/g)	Gamma Range			Notes
							min	max	avg	
V-1	PAB 425	0-6	590.3	736	3.4		550	650		Post Flood Verification Composite Sample - Config. 5



**Attachment 1.**  
**Utah DNR Visit**

## Attachment 1. Utah DNR Visit



### State of Utah

#### DEPARTMENT OF NATURAL RESOURCES

MICHAEL R. STYLER  
*Executive Director*

#### Division of Wildlife Resources

GREGORY J. SHEEHAN  
*Division Director*

Moab UMTRA Project  
U.S. Department of Energy Grand Junction  
200 Grand Avenue, Suite 500  
Grand Junction, CO 81501

cc: Katherine Creighton and Justin Hart

Ken Pill,

The Utah Division of Wildlife Resources Moab Field Station sampled three isolated pools at the Moab UMTRA site on 7/14/2014 and 7/16/2014 to determine if any of the four endangered Colorado River fishes (Colorado pikeminnow, razorback sucker, humpback chub, or bonytail) were present. The isolated pools were created from high flows in the Colorado River and were located in the well field on the southern end of the Moab UMTRA site. No endangered fish were present in these isolated pools. The fish assemblages of the pools consisted of several nonnative species including common carp, fathead minnow, red shiner, sand shiner, and Western mosquitofish and one native species; flannelmouth sucker. If you have any questions or concerns you may contact Brian Hines ([bhines@utah.gov](mailto:bhines@utah.gov)) or Katie Creighton ([katherinecreighton@utah.gov](mailto:katherinecreighton@utah.gov)).

Thank you,

Brian Hines  
Fisheries Biologist  
UDWR Moab Field Station  
1165 S. Hwy 191 Ste 4  
Moab, UT 84532  
435-259-3782